July 26, 1938. E. V. HENNECKE 2,125,262

SUCTION MOTOR

Filed Jan. 7, 1935

Fig. 1.

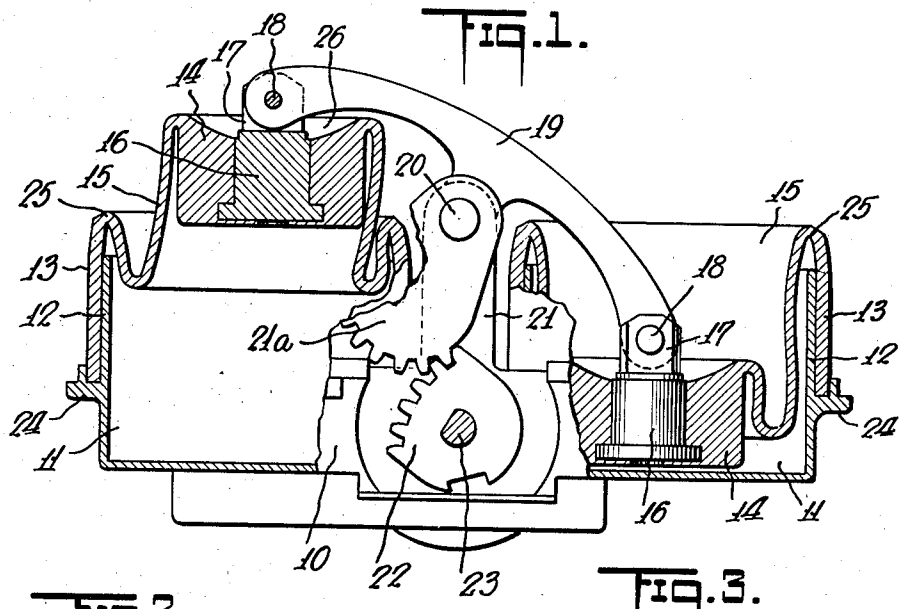


Fig. 2.

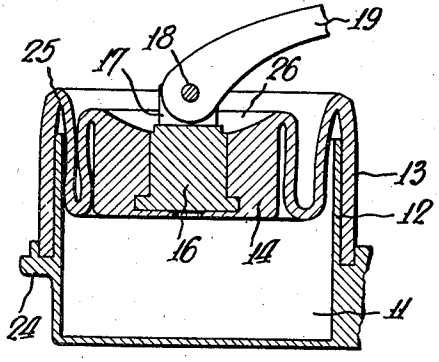


Fig. 3.

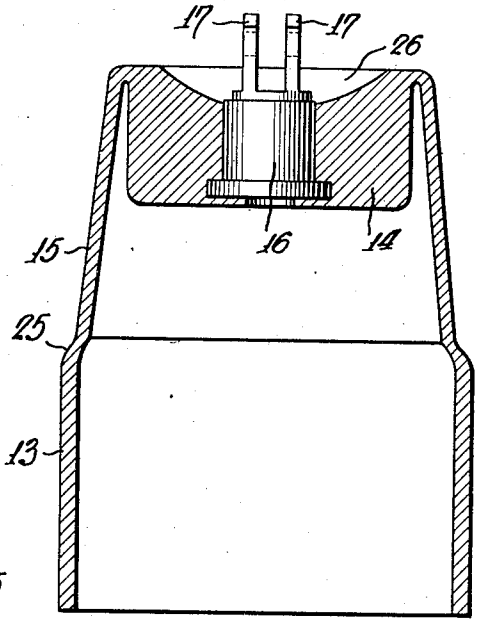
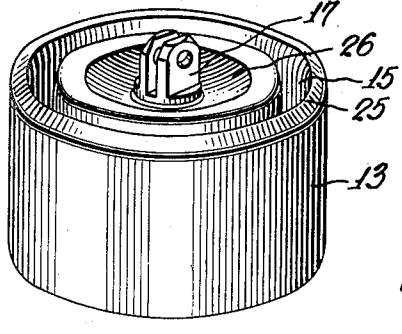


Fig. 4.



INVENTOR
Earle V. Hennecke
BY
Dunn, Fairbanks, Ithis & Inter
ATTORNEYS

Patented July 26, 1938 2,125,262

UNITED STATES PATENT OFFICE

2,125,262

SUCTION MOTOR

Earle V. Hennecke, Flushing, N. Y.; Margaret Bernadette Hennecke, administratrix of said Earle V. Hennecke, deceased, assignor to Automotive Equipment, Inc., a corporation of New York

Application January 7, 1935, Serial No. 691

21 Claims. (Cl. 121—48)

This invention relates to suction motors for operating windshield cleaners or the like in which air is alternately exhausted from and admitted to a pair of collapsible walled working chambers, each chamber comprising a socket and a distortable member closing the mouth of the socket. The central portions of the distortable members are connected to a power transmitting, motion translating train which converts the suction induced movement of the collapsible chamber walls into an oscillating movement of the power take-off shaft.

Among the objects of the invention are to provide a suction motor of this type in which a working chamber having a collapsible rubber wall so designed that there will be little or no wear or chafing of rubber against metal parts and no braking action of rubber against rubber as the chambers are alternately reduced and enlarged; in which the need for special air tight connections between the power applying resilient members and the power take-off mechanism is obviated; in which the over-all size of the motor is reduced; in which the construction is simplified by the elimination of parts and assembly is expedited and facilitated and the cost of manufacture decreased; in which greater power is obtained by the elimination of friction and leak and by the use of a collapsible chamber wall opposing but negligible inherent resistance to flexure; and in which the distortable members are under substantially no tension when the motor is idle and the shelf life of the rubber is thus prolonged.

The invention may be more fully understood from the following description in connection with the accompanying drawing wherein:—

Fig. 1 is a view mainly in longitudinal section and partly in side elevation of a motor embodying the invention,

Fig. 2 is a fragmentary view showing one of the motor chambers when the walking beam is in its central or neutral position,

Fig. 3 is an enlarged view showing the cross-sectional shape of the collapsible bag as it comes from the mold, and

Fig. 4 is a perspective view showing the substantially untensioned position normally assumed by the bag when the reinforced bag center has been folded inwardly through the bag skirt.

In the drawing 10 designates the body or base of the motor preferably in the form of a casting which includes a pair of spaced parallel socket members 11, the mouths of which, indicated at 12, are in the form of externally cylindrical extensions of the socket. Telescoped over the socket mouths 12 are the skirt portions 13 of collapsible rubber bags. At the bag centers are inwardly extending generally cylindrical reinforcing members, shown in the form of rubber plugs or blocks 14, these blocks being of a diameter appreciably less than the internal diameter of the sockets 11 and being integrally connected to the skirt portions of the bag by inwardly extending annular bight forming portions 15.

Molded into the blocks or plugs, or reinforced bag centers 14 are flanged metallic connector pieces 16 presenting a pair of upstanding apertured ears 17 to be pivotally connected as at 18 to the ends of a walking beam 19. This walking beam is fixed intermediate its ends upon a rock shaft 20 mounted in a boss 21 rising from the base member 10 between the two working chambers. Also keyed upon the rock shaft 20 is a gear 21a transmitting motion through a gear 22 to a second rock shaft 23 disposed directly under the first rock shaft 20, the shaft 23 being adapted to carry a windshield wiper or to indirectly actuate a windshield wiper.

Annular trough-like members 24 integral with the cylindrical mouths of the sockets 11 limit the extent to which the bag skirts may be telescoped over the mouths of the sockets. The skirt portions 13 of the bags are of greater thickness than the bight portions 15 and a hinge connection or predetermined fold line between the bight and skirt is afforded by making that portion of the bag at the juncture of the bight and skirt of even less thickness than the bight portion itself, this weakened hinge line being indicated at 25.

The bags are molded as illustrated in Fig. 3 with the skirts approximately cylindrical with the bight portions offset slightly inwardly with respect to the skirt and tapering from their point of connection with the skirts to their point of juncture with the blocks or reinforcing members 14.

Each member 14 is externally centrally depressed or dished as indicated at 26 to the end that the pivotal connection 18 need not be unduly elevated above the top of the bag. The ears 17 are exposed at the centers of these depressions and the depressions afford clearance for the pivoted ends of the walking beam.

Reference may be had to Kuskin Patent No. 2,045,861 for a complete disclosure of one suitable form of snap-valve mechanism and an arrangement of passages and ports for alternately connecting the two working chambers with the at-

mosphere and with a source of suction. In operation the bag centers are alternately drawn inwardly as air is exhausted from the working chambers, thereby imparting motion to the walking beam which is translated into oscillating motion of the rock shaft 23.

When the central reinforced portion 14 of the molded bag illustrated in Fig. 3 is thrust downwardly into the skirt portion of the bag, the bight, hinging on the line 25, falls into place between the block 14 and the skirt of the bag so that the bag assumes the position illustrated in Fig. 4 in which position there will be no inherent tendency of the reinforced bag center to move either inwardly or outwardly and no portion of the bag will be under tension with the exception of the bight which is self-tensioning due to the folding which has occurred. It is this position which the bag assumes when the walking beam 19 is in its central or neutral position and this is a very important feature because when these motors are stored on a dealer's shelf, the walking beam will be in its intermediate position; both of the bags will be in the position illustrated in Figs. 2 and 4 and will be under substantially no tension, whereby the shelf life of the motor may be very materially prolonged.

Another important feature is the complete elimination of metal guide cups or floating sleeves such as shown in Kuskin Patents No. 1,912,777 and No. 2,045,861 within the working chambers, since these parts tend to chafe against the rubber of the bag and cause wear. Also by making the block or central reinforcing member 14 of substantially less diameter than the diameter of the socket 11, there will be substantially no tendency of the run of the annular bight to drag or chafe against itself or the socket wall or the reinforcing plug 14. It is true that as the bag center moves inwardly from the position shown in the left hand side of Fig. 1 to the position shown in the right hand side of Fig. 1, the bight will tend to be drawn against the inside wall of the socket 11 and to be unfolded or unpeeled from the block 14 but this is a straight folding action so that no chafing occurs. On reverse movement of the bag the bight portion in effect peels from the inner walls of the socket and again tends to fold against the block 14.

The use of a hinge line 25 assures correct folding of the bags so that by simply depressing the center from the position shown in Fig. 3, the bags will assume the substantially untensioned position of Fig. 4. It is also important that the so-called bight portion 15 be appreciably thinner than the skirt portion of the bag since substantially all of the flexing occurs at the bight and the thinner the rubber the less resistance it opposes to flexing. The skirt portions themselves are of course highly flexible and when air is exhausted from the interior of a working chamber, these skirts tend to more snugly hug the cylindrical socket mouths whereby the entry of air under the skirts on the suction stroke is precluded. Obviously the skirt portion or base of the bag may be of any suitable form adapted to be held in sealing engagement with the mouth of the socket member, the only essential feature being that a tight fit be secured so as to prevent leakage into the motor chamber. By molding the walking beam connection integral with the block 14 I not only eliminate many small parts and simplify the cost of manufacture but it becomes entirely unnecessary to provide special means for sealing against the leakage of air at the point of connection of the bag centers to the walking beam.

It will be apparent that the working chamber formed by the use of my improved bag is not only absolutely air-tight but that the action of the collapsible chamber walls is substantially frictionless due to the thin and highly flexible nature of the rubber used in the bight portions of the bags or diaphragms, and to the fact that a rolling rather than a sliding action takes place between the flexible bag and the walls of the socket and central reinforcement.

Connecting the ends of the walking beams directly to the bag tops eliminates the necessity for the link connection illustrated in the Kuskin patents and while the reinforced bag centers will, during reducing and enlarging of the chambers, have a slightly greater lateral traverse as an incident of their vertical movement due to their direct connection to the walking beam, such traverse becomes of no moment because of the highly flexible nature of the bags themselves and the relatively small diameter of block 14.

While I do not wish to be limited to dimensions, it is worthy of note that highly satisfactory results have been obtained commercially by the use of a rubber bag the skirt portion of which is 1½" in internal diameter and the plug portion of which is 1⅛" in diameter, with the bight portion having a thickness of roughly 3/64 of an inch; the skirt having a thickness of roughly 1/16 of an inch and the fold line having a thickness of approximately 1/32 of an inch.

While I have illustrated and described a suction motor embodying two working chambers and of the type which is suited for use in operating windshield wipers, it is to be understood that it is within the scope of the invention to provide motors utilizing one, two or more working chambers and that such motors may be designed for light duty as well as heavy duty work, typical uses for such motors being the actuation of air brakes, or direction signals or fuel pumps on automobiles and in all such cases either the intake manifold may serve as the source of suction or any other suitable suction inducing means may be used.

It will thus be seen that there is herein described apparatus in which the several features of this invention are embodied, and which apparatus in its action attains the various objects of the invention and is well suited to meet the requirements of practical use.

As many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:—

1. In a suction motor, a power take-off member, a collapsible walled working chamber, comprising a cup-shaped diaphragm which constitutes a collapsible wall of said chamber and includes at its center a soft inwardly extending block, and means extending into, and only part way through said block from the exterior thereof, for connecting said block to said power take-off member.

2. In a suction motor, a collapsible walled working chamber, comprising a cup-shaped diaphragm constituting the collapsible wall of said

chamber, said diaphragm including at its center a soft inwardly extending block-like cylindrical reinforcement.

3. In a suction motor, a collapsible walled working chamber, comprising a fixed wall portion and a cup-shaped diaphragm which constitutes the collapsible wall of said chamber, said diaphragm including at its center a solid inwardly extending soft block-like reinforcement, said reinforcement being of cylindrical shape and of appreciably less diameter than the diameter of the chamber, and an annular inwardly extending reentrant bight portion connecting the block and the fixed portion of the chamber wall and adapted to be folded double between the block and the fixed portion of the chamber wall.

4. In a suction motor, a collapsible walled working chamber, comprising a diaphragm constituting the collapsible wall of said chamber, said diaphragm including at its center a soft inwardly extending block-like cylindrical reinforcement, and means for connecting the diaphragm through said block to a power take-off mechanism and including a connecting means which extends into the block from the exterior thereof, is partially embedded in the block, and terminates short of the inner surface of the block.

5. In a suction motor, a collapsible walled working chamber including a rigid socket member having a cylindrical mouth, and a distortable bag including a base portion in sealed engagement with the mouth of the socket, the central portion of said bag including a reinforcing member having a cylindrical surface extending into the interior of the suction chamber, that portion of the bag between the base and the reinforcing member extending inwardly in the form of a reentrant annular bight, the portion of the bight formed by that part of the bag wall adjacent to the reinforcing member lying against and being at all times supported against collapse by engagement with the inwardly extending cylindrical surface of said reinforcing member.

6. In a suction motor, a collapsible walled working chamber including a rigid socket member having a cylindrical mouth, and a distortable bag including a skirt portion telescoped over the mouth of the socket, the central portion of said bag including an inwardly extending cylindrical reinforcing block, that portion of the bag which connects the skirt and the block extending inwardly in the form of a reentrant annular bight, said bight portion being of less thickness than the skirt portion.

7. In a suction motor, a collapsible walled working chamber including a rigid socket member having a cylindrical mouth, a distortable bag including a skirt portion telescoped over the mouth of the socket, the central portion of said bag including an inwardly extending cylindrical integral reinforcing block, that portion of the bag which connects the skirt and the block extending inwardly in the form of a reentrant annular bight folded double between the skirt and the block, said bag at the line of juncture of the skirt and bight being of decreased thickness affording a fold line upon which the bight portion folds inwardly with respect to the skirt portion to assure that one fold of the bight will extend close to the skirt portion.

8. In a suction motor, a collapsible walled working chamber including a rigid socket member having a cylindrical mouth, a distortable bag including a skirt portion telescoped over the mouth of the socket, the central portion of said bag including an inwardly extending cylindrical integral reinforcing block, that portion of the bag which connects the skirt and the block extending inwardly in the form of an annular bight, said bight portion being of less thickness than the skirt portion, and said bag at the line of junction of the skirt portion and bight portion being of further decreased thickness to predetermine a fold line on which the bight and the bag center which it carries fold inwardly.

9. In a suction motor, a collapsible walled working chamber including a rigid socket member having a cylindrical mouth, a distortable bag including a skirt portion telescoped over the mouth of the socket, the central portion of said bag including an inwardly extending cylindrical integral reinforcing block, that portion of the bag which connects the skirt and the block extending inwardly in the form of a reentrant annular bight, folded double between the socket and the block, said bight when so folded assuming a substantially stable condition.

10. In a suction motor, a collapsible walled working chamber including a rigid socket member having a cylindrical mouth, a distortable bag including a skirt portion telescoped over the mouth of the socket, the central portion of said bag presenting an inwardly extending cylindrical reinforcing block, that portion of the bag which connects the skirt and the block extending inwardly in the form of a reentrant annular bight, said reinforced bag center when moved into the skirt of the bag, assuming a substantially untensioned position, with the top of the reinforcement approximately flush with the top of the skirt and with the bight folded double between the skirt and the reinforcement.

11. As a new article of manufacture, a rubber bag adapted to be telescoped over the cylindrical mouth of a socket and to cooperate with said socket to afford a collapsible walled working chamber, said bag including a generally cylindrical skirt portion, a generally frusto-conical portion extending upwardly and inwardly from said skirt and a cylindrical reinforcing block connected to the upper end of said frusto-conical portion, said frusto-conical portion being adapted to constitute a reentrant bight when the block portion is forced inwardly into the skirt and to lie folded double between said block and skirt.

12. As a new article of manufacture, a rubber bag adapted to be telescoped over the cylindrical mouth of a socket and to cooperate with said socket to afford a collapsible walled working chamber, said bag including a generally cylindrical skirt portion, a generally frusto-conical portion extending upwardly and inwardly from said skirt and an integral cylindrical reinforcing block connected to the upper end of said frusto-conical portion, said frusto-conical portion being adapted to constitute a bight when the block portion is forced inwardly into the skirt and to lie between said block and skirt, said skirt being of greater thickness than the bight forming portion to form a predetermined fold line at their juncture on which the bight folds inwardly as the reinforced center or top of the bag is moved into the skirt.

13. As a new article of manufacture, a rubber bag adapted to be telescoped over the cylindrical mouth of a socket and to cooperate with said socket to afford a collapsible walled working chamber, said bag including a generally cylindrical skirt portion, a generally frusto-conical portion extending upwardly and inwardly from

said skirt and in integral cylindrical reinforcing block connected to the upper end of said frusto-conical portion, said frusto-conical portion being adapted to constitute a bight when the block portion is forced inwardly into the skirt and to lie between said block and skirt, said skirt being of greater thickness than the bight to form a predetermined fold line at their juncture on which the bight folds inwardly as the reinforced center or top of the bag is moved into the skirt, said fold line being so designed that the block assumes a substantially untensioned position within the skirt when thrust downwardly into the skirt.

14. In a suction motor a collapsible walled working chamber including a rigid socket forming portion and a diaphragm closing the mouth of said socket portion and adapted to be drawn inwardly by suction to reduce said working chamber, said diaphragm including a central reinforcement whose inner end is of the same shape as the end wall of the socket forming portion, and a reentrant bight forming portion disposed between said central reinforcement and the rigid wall of the socket.

15. In a suction motor, a collapsible rubber bag having a skirt portion adapted to be held comparatively rigid, and having a collapsible bight portion adapted to be folded within said skirt portion in close proximity thereto, said bight portion being of smaller diameter than said skirt portion to form a readily foldable annular region between said portions about which said bight may be collapsed in the interior of said skirt, said bight portion having an inwardly extending integral block for effecting the well-regulated collapse of the bight portion into the interior of said skirt portion in close proximity thereto when in collapsed condition.

16. In a suction motor, a working chamber of variable volume comprising a rigid socket and a flexible diaphragm secured thereto, said diaphragm comprising a base portion secured marginally to the socket, a central inwardly extending cylindrical reinforcing member of substantially less diameter than the socket, and a flexible connecting wall extending between the base portion and the outer end of said reinforcing member, said wall forming a reentrant fold between the base portion and the reinforcing member at all times, and means limiting the outward movement of the reinforcing member to a position in which the reentrant fold is present.

17. In a suction motor, a working chamber of variable volume comprising a rigid socket and a flexible diaphragm secured thereto, said diaphragm comprising a skirt portion secured marginally to the socket, a central inwardly extending cylindrical block of substantially less diameter than the socket, and a flexible connecting wall extending between the skirt portion and the block, said wall forming a reentrant fold between the skirt portion and the block at all times, and means limiting the outward movement of the block to a position in which the block overlaps the skirt portion.

18. In a suction motor, a working chamber of variable volume comprising a rigid socket and a flexible diaphragm secured thereto, said diaphragm comprising a skirt portion secured marginally to the socket, a central inwardly extending cylindrical block of substantially less diameter than the socket, and a flexible connecting wall extending between the skirt portion and the block, said wall forming a reentrant fold between the skirt portion and the block at all times, and means controlling the length of stroke of the block, the thickness of the block being substantially half the length of the working stroke, and the length of the connecting wall being substantially the same as the length of the working stroke.

19. In a suction motor, a working chamber of variable volume comprising a rigid socket and a flexible diaphragm secured thereto, said diaphragm comprising a skirt portion secured marginally to the socket, a central inwardly extending cylindrical block of substantially less diameter than the socket, and a flexible connecting wall extending between the skirt portion and the block, said wall forming a reentrant fold between the skirt portion and the block at all times, and means controlling the length of stroke of the block, the thickness of the block being substantially half the length of the working stroke, and the length of the connecting wall being substantially the same as the length of the working stroke, the arrangement being such that substantially the lower half of the connecting wall is folded double between the socket and the block at the outer limit of movement, and substantially the upper half of the connecting wall is folded double between the socket and the block at the inner limit of movement.

20. In a suction motor, a working chamber of variable volume comprising a rigid socket and a flexible diaphrgam marginally secured thereto, said diaphragm comprising a central inwardly extending cylindrical block of substantially less diameter than the socket, and a flexible wall connecting the socket and the block, and means limiting the stroke of the block, said connecting wall being long enough to form a reentrant fold between the socket and the block in all operative positions of the block, but not long enough to expose substantially more than one-half of the length of the wall below the block at the outer limit of the operating stroke.

21. In a suction motor, a working chamber of variable volume comprising a rigid socket and a flexible diaphragm secured thereto, said diaphragm comprising a skirt portion secured marginally to the socket, a central, inwardly extending, relatively rigid member having an outer wall of substantially less diameter than the socket, and a flexible connecting wall extending between the skirt portion and said inwardly extending member, said flexible wall forming a reentrant fold between the skirt portion and the central, inwardly extending member at all times and extending at least part of the time within the inner wall of the socket, and means limiting the outward movement of the inwardly extending member to a position in which the reentrant fold is present.

EARLE V. HENNECKE.